DEVELOPMENT OF THE EARLY TYPES OF LOCOMOTIVES USED BY THE BALTIMORE AND OHIO RAILROAD COMPANY

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SUBMITTED

BY

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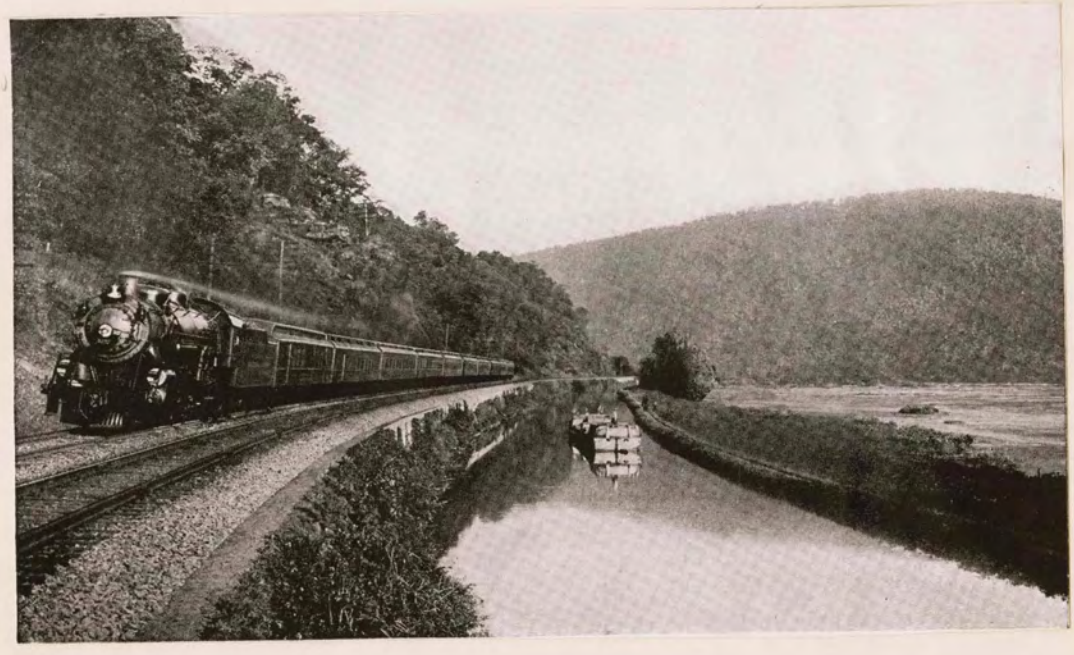


THE MAIN LINE OF THE B & O ABOVE HARPERS FERRY

DEVELOPMENT OF THE EARLY TYPES OF LOCOMOTIVES USED BY THE BALTIMORE AND OHIO RAILROAD COMPANY.

It has been for some time so extremely easy to ride a fast passenger train to nearly any point one may wish to go, that one usassailable fact has quite generally been forgotten, or at least, unnoticed and overlooked. This fact is, - that the railroad, as a transportation vehicle, which does this carrying, had to have it's beginning.

In America this beginning occurred not quite one hundred years ago.

In 1827 a group of people in Baltimore, Maryland, organized and obtained a charter for the Baltimore and Ohio Railroad Company, the object of which was to provide overland transportation from Baltimore to the Ohio River. It was the original plan of the officials to operate this road by steam, even though many people thought that this idea would never be practical. However, through the faith of some of the more progressive members and interested parties, the original plan was finally carried out.

It must be remembered that at the time of organization the company had no trackage and no rolling stock of any kind, and no incentive other than the vision and faith of its organizers already mentioned.

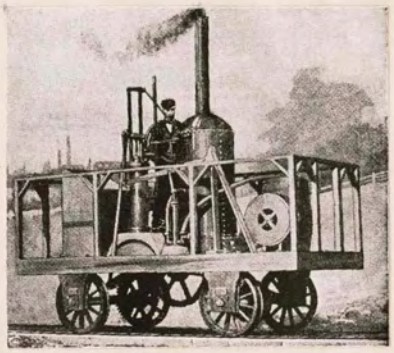
However, in 1830, the first section of the Baltimore and Ohio Railroad Company trackage was completed. This ran from Baltimore to Ellicott's Mills (now Ellicott City), a distance of fifteen miles, and during the next two years, the road was extended to Frederick, Maryland. The road was first operated by horse power and for a while it was an open question as to whether horse or steam power would be the more satisfactory mode of operation. Reports of success with steam operation in England in 1829 proved the deciding factor and actual experimentation with steam engine locomotives began in this country.

One of the organizers, Peter Cooper, who was a merchant in Baltimore, Maryland, built a small locomotive which he called the "Tom Thumb" in 1829. This was the first steam locomotive ever used in America. This was a small four wheeler, hardly larger than a modern hand car, having one upright cylinder, three and one-four inch bore by thirteen and one-half inch stroke. This cylinder was placed "upside down", or the cylinder head was underneath. The piston rod connected to a horizontal member which ran in guides similar to a modern cross head, and from one end of this cross member, a connecting rod ran to a short shaft carrying a spur gear which meshed with an intermediate or idling gear which in turn meshed with a large gear fixed on one axle of the locomotive.

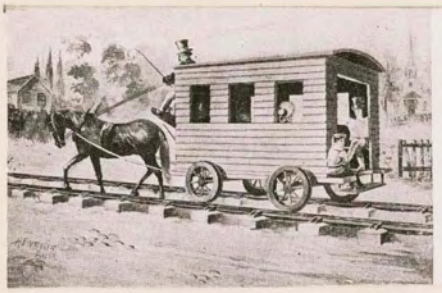
The boiler was vertical, and was a fire tube boiler, using gun barrels as tubes. The fire box was very small, and the fire gas area very small, so that a fan was necessary to create draft enough to maintain steam. The "Tom Thumb" actually did work, and was a definite progressive step in the right direction. The company had carried on experiments with sail cars, one - the "Thomas" sail car, named the "Meteor" actually attained a speed of twenty miles per hour alone, but was incapable of drawing any load, and a second, the "Aeolus" would not even perform creditably alone; also horse locomotives were experimented with - that is, horses providing the motive power through a treadmill, but these trials were experiments only and nothing more.

It was the "Tom Thumb" which weighed less than one ton and developed barely one horse power which really gave impetus to the Railroad.

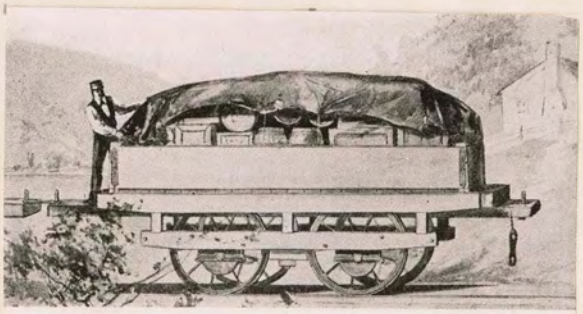
The success of the "Tom Thumb" encouraged the company to try to develop better engines, so in 1831 the company offered a premium of four thousand dollars for the most approved locomotive that would be delivered for trial upon the road, on or before the first of June 1831, and three thousand five hundred dollars for the engine that would be adjudged the next best. The requirements



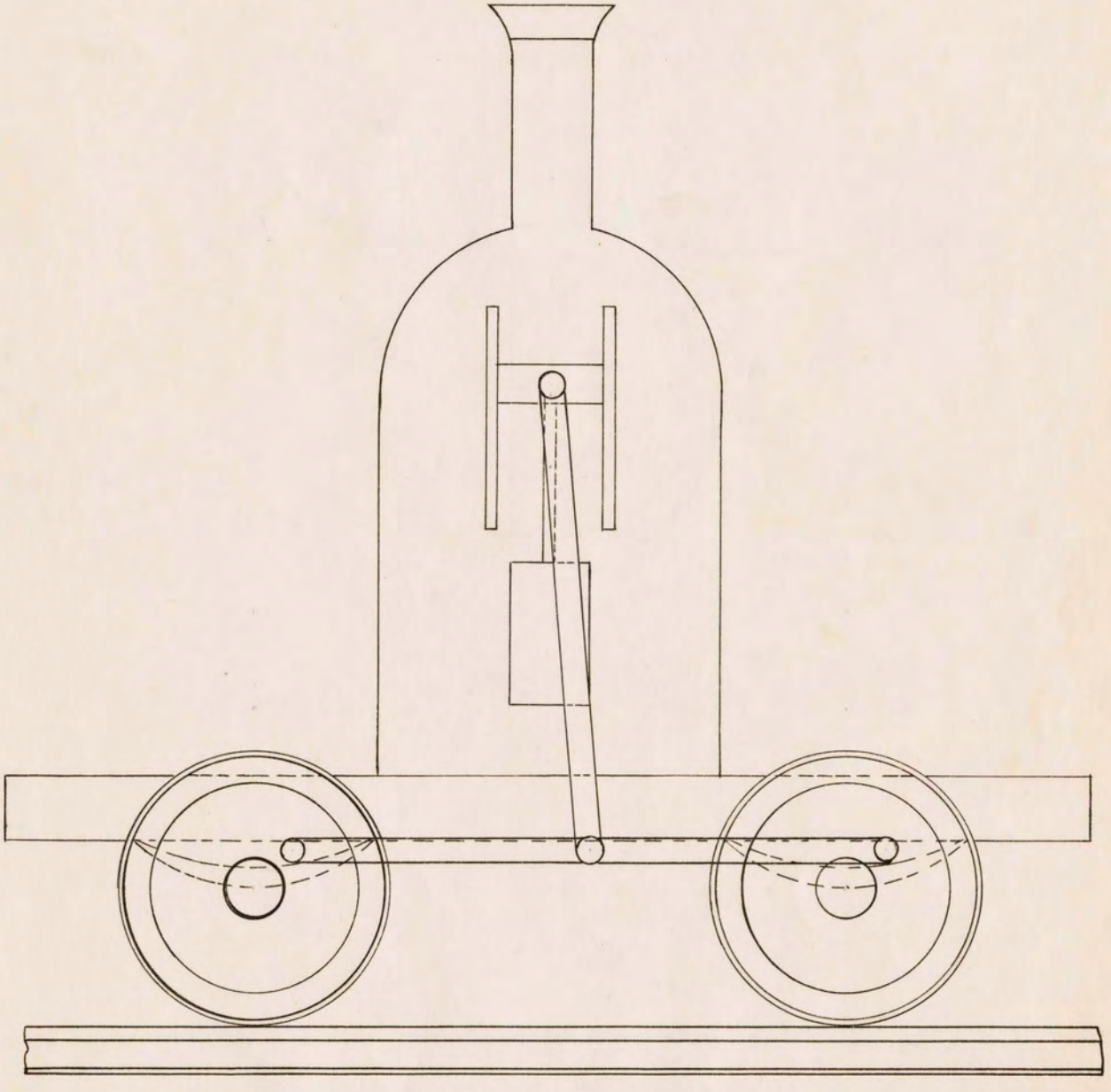
THE TOM THUMB



The steam engine was an unknown factor before 1830 so the first B. & O. passenger car was a one-horse affair



This is a B. & O. freight car of 1832— the first operated by the road



THE "YORK"

Line diagram

were as follows:-"The engine when in operation must not exceed three and one-half tons weight, and must on a level road be capable of drawing day by day fifteen tons inclusive of the weight of wagons, fifteen miles per hour."

This contest developed five engines which may be described as follows:-

1. Johnson Engine, - made by G. W. Johnson, a machinest of Baltimore.

   This engine had four wheels, two of which were drivers, these being placed under the fire box. It had two vertical cylinders one on each side of the foot board, a walking beam on top of the fire box, and used a horizontal boiler with twin fire boxes.

2. The "York", - made by Davis and Gartner from designs by Phineas Davis.

   This was also a four wheeler using an upright boiler and two cylinders, one on each side of the boiler. This engine was one of the first to have the now conventional cross-head installed. From the cross-head a connecting rod ran to the center of the driving rod connecting both wheels on a side, so that the York was the first outside connected four-wheeled driver. This engine had the disadvantage that the spring action changed the clearance in the cylinder so much that the cylinder had to be so long that it was highly inefficient. The engine complete weighed about eight thousand pounds. (Note: See accompanying line diagram).

3. Costell, - built by Stacey Costell, a watch maker.

   This was a novel engine having two oscillating cylinders pivoted under the boiler on a common shaft in the frame. The power was transmitted to the wheels through gearing from a counter shaft.

A four way cock was used for valves and also served the purpose of a reverse gear.

4. Child's Rotary - using one rotary cylinder with steam fed from from a center port and emitted at the opposite end. Details are not available for this engine, but it proved to be no good, although a splendid example of ingenuity.

5. James Engine - another four wheeler, which had horizontal cylinders. The novelty of this engine was that it had two eccentrics for each cylinder, connecting with a curve reversing lever.

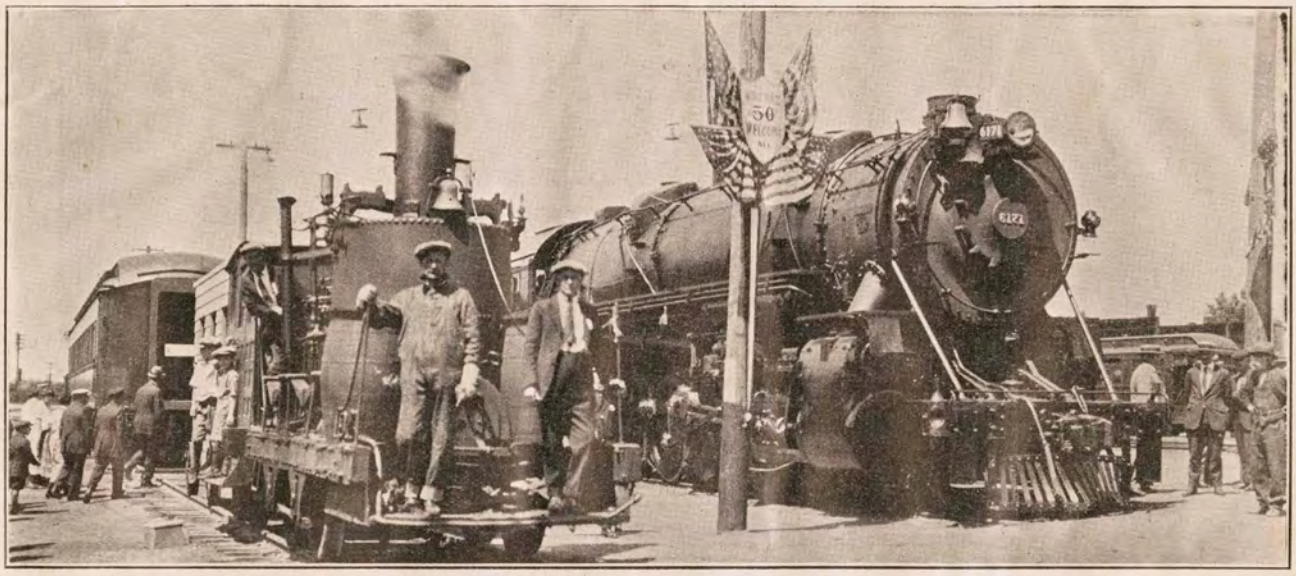
This contest was won by the "York" which was altered to obviate the spring action. Incidentally the "York" was the first engine to be equipped with steel springs.

From the "York" it was only a step to the "Atlantic" which became the first standard type used by the Baltimore and Ohio Railroad. The "Atlantic" had two vertical cylinders placed on the frame near the boiler and connected through cross heads and connecting rods with walking beams pivoted near the top of the vertical boiler. From the ends of the beams connecting rods ran to cranks on a shaft carrying a spur gear which was geared to a live axle in the ratio of two to one, so that the engine having three foot drivers was equivalent to one having six foot drivers. The two cylinders were each ten by twelve and the engine operated most successfully. Because of the high joints and up and down action of the connecting rod the engine was known as the "Grasshopper Type." There were twenty of these engines built and some were in actual operation from 1832 to 1895.

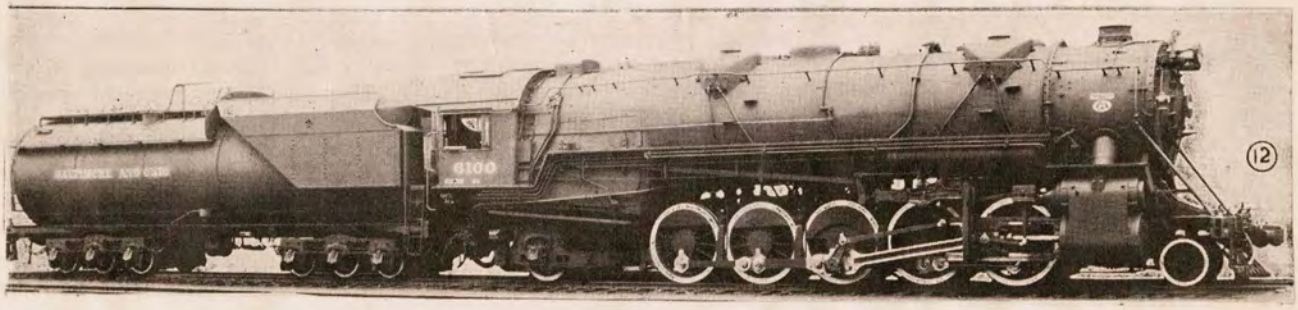
The performance record of this engine is as follows:-

Weight of engine six and one-half tons equals fourteen thousand, five hundred and sixty pounds.

Cylinders - two - ten by twenty.



The old and the new—Atlantic and Mikado at Willard Golden Jubilee. The former could haul fifteen tons fifteen miles an hour. The latter takes five thousand tons over the hills much faster



A SIDE VIEW OF THE 6100 SERIES LOCOMOTIVE

Drivers thirty-six inches.

Steam pressure - fifty pounds gage - sixty-five pounds absolute.

Gross load hauled to Parr's Ridge, a distance of fifty miles, up a grade rising thirty-seven feet in a mile - fifty long tons at speeds ranging from twelve to fifteen miles per hour.

The total cost for an eighty mile run was sixteen dollars, including one ton of anthracite coal at eight dollars, wages of engine man, tender, and laborer, three dollars and fifty cents, oil and packing fifty cents, wear and tear (estimated) and interest on the investment three dollars, and water station expense of one dollar. The engine replaced forty-two horses which cost thirty-three dollars to maintain. The total cost of the engine was approximately fourthousand five hundred dollars.

It may not be amiss at this point to mention some of the type of boilers used on these early engines. It is needless to say that much progress has been made, although many of the features introduced on the early engines, are maintained today, from the boiler to the flanges on the wheels.

As has been stated, the boiler used on the "Tom Thumb" was a fire tube boiler using gun barrels as tubes. This boiler worked well so long as a draft could be maintained to keep the fire going. This necessity was proved in a rather humorous way, when in 1830 a race was run between a one car train hauled by the "Tom Thumb" and a one car train hauled by a horse. The engine puffed itself serenely away from the horse drawn vehicle until the fan which was used to create draft in the flue ceased to operate through the failure of the belt used to drive it. Nowadays the result would be called " a moral victory" for steam.

Next, in the latter part of 1829 and in 1830 the cheese boiler was introduced. It was a plain open dome boiler which had a portion of the water held over the fire in the combustion space by means of a large tank

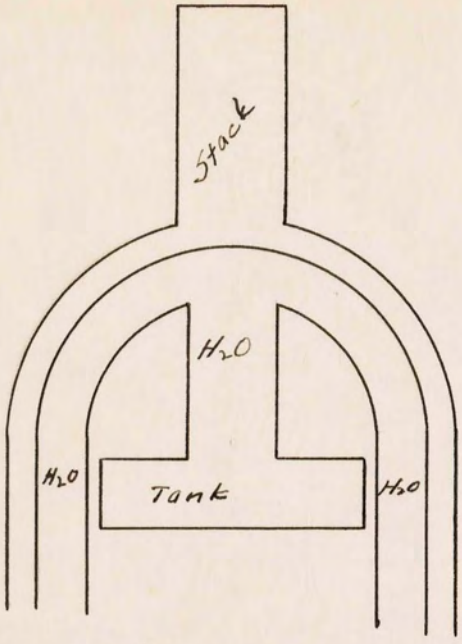
suspended from the center of the dome by a pipe. (See line diagram).

This boiler proved unsatisfactory because of sediment and scale soon clogged the water tank and the jacket soon burned out, making the upkeep a nuisance and prohibitively expensive.

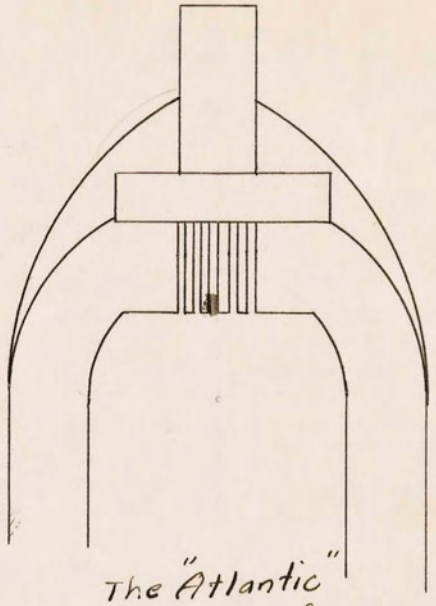
Then in 1830 a modification was made which improved matters greatly. From the top of the combustion chamber a series of tubes were extended vertically which terminated in a chamber above the water line which had a single outlet through the stack. (See line diagram). This, however, was wasteful of heat, and therefore expensive, so in the "Atlantic" a modification of this type was made, which was retained until the vertical boiler was discarded in favor of the horizontal boiler. This modification was in effect to raise the upper gas chamber nearly to the top of the boiler so that a large increase in heating surface was secured. (See line diagram). This type of vertical boiler was the only really successful one, and its success may be noted by reference to the performance record of the "Atlantic", given elsewhere in these pages.

Horizontal boilers did not come into general use for quite a few years, the first being introduced about 1850 on a locomotive known as the Camel type in which the boiler was placed very high with the working parts placed underneath.

These later locomotives were the result of an advertisement by the Baltimore and Ohio Railroad in the American Railroad Journal of October 23, 1847, of its need for heavy freight locomotives. This advertisement is given on the next three sheets.



The "Cheese" Boiler



The "Atlantic" type of Boiler.

To Locomotive Engine Builders:-

Proposals under seal will be received by the undersigned up to Saturday, the 6th of November inclusive, for furnishing the Baltimore and Ohio Railroad Company with four locomotive engines in conformity with the following specifications:-

1. The weight not to exceed twenty tons of two thousand two hundred and forty pounds and to come as near to that limit as possible.

2. The weight to be uniformly distributed over all the wheels when the engine is drawing the heaviest load.

3. The number of wheels shall be eight.

4. The diameter of the wheels shall be forty-three inches.

5. The four intermediate wheels shall be without flanges.

6. The boiler to contain not less than one thousand square feet fire surface, of which there shall be not less than one-fifteenth in fire box.

7. The tubes shall be of number eleven flue iron, with a space of not less than three-fourths of a foot between them and the tube sheets.

8. Fire box, except tubes and crown sheets, to be of copper two-thirds of an inch thick.

9. Tube sheets to be three-eighths of an inch thick.

10, The boiler to be of number three iron of the best quality.

11. The fire box to be not less than twenty-four inches below the cylindrical part of the boiler.

12. Steam to be taken to the cylinder from a separate dome on the fore part of the boiler.

13. The frame including the pedestals to be entirely of wrought iron and the boiler to be connected therewith, so as to allow of contractions and expansions without strain on either.

14. The cylinder to be twenty-two inch stroke and not less than seventeen inch diameter.

15. The cut-off to be effected by a double valve worked by separate eccentrics.

16. The angle of the cylinder to be not greater than thirteen and one-half degrees with the horizontal line.

17. The frame and bearings to be inside the wheels and the direction from the cylinder direct with the back pair of intermediate wheels.

18. The centers of extreme wheels to be not more than eleven and one-half feet apart.

19. The wheels to be of cast iron with chilled tire.

20. The means to be provided of varying the power of the exhause in the blast pipe.

21. The engine to be warranted to do full work with Cumberland or other bituminous coal in a raw state as the fuel, - and the furnace to be provided with an upper and lower fire door with that view.

22. The smokestack to be provided with a wire gauze covering.

23. Two safety valves to be placed upon the boiler, each containing not less than five square inches of surface and one to be out of reach of engine man.

24. The tender to be upon eight wheels and constructed upon such a plan as shall be furnished by the company and to carry not less than three cords of wood or its equivalent in coal, and fifteen hundred gallons of water.

25. The materials and workmanship to be of the best quality, - the

engine to be subjected to a trial of thirty days steady work with freight upon the road before acceptance by the company.

Incidentally, the Hayes "Camel", in 1853, was the original ten wheeler used by the Baltimore and Ohio and was the first locomotive to cross the Alleghanies.

It must be remembered that before this time the Baltimore and Ohio Railroad was a well organized and smoothly operating concern. In fact, the first time table on record was published by the Baltimore and Ohio, and read as follows:-

"A sufficient number of cars now being provided for the accommodation of passengers, notice is hereby given that the following arrangements for the arrival and departure of carriages have been adopted, and will take effect on and after Monday morning next the 5th instant, viz.:

"A brigade of cars will leave the depot on Pratt St. at 6 and 10 1'clock A. M., and at 3 to 4 o'clock P. M., and will leave the depot at Ellicott's Mills at 6 and 8½ o'clock A. M., and at 12½ and 6 P. M.

"Way passengers will provide themselves with tickets at the office of the Company in Baltimore, or at the depot at Pratt Street and Ellicott's Mills, or at the Relay House, near Elk Ridge Landing.

"The evening way car for Ellicott's Mills will continue to leave the depot, Pratt St., at 6o'clock P. M. as usual.

"N. B. Positive orders have been issued to the drivers to receive no passengers into any of the cars without tickets.

"P. S. Parties desiring to engage a car for the day can be accommodated after July 5th."

It may be noted that the first railroad freight station in America and perhaps in the world, was built at Frederick, Maryland, in 1829. It was a

stone structure and was rebuilt in 1912, because it was not large enough to handle the present traffic. It was a rather pretenticus affair, having a handsome belfry. When the station was rebuilt in 1912, the belfry was retained, but by some mischance, the bell is now in Martinsburg, West Virginia, at the shops of the company which are located there.

The success of the company and its present popularity and actuality would not be extant except for the purposeful work and enthusiasm of its founders and early operators. This success was in great measure due to the development of the "Atlantic" type of locomotive which turned out to be so successful. Mr. Benjamin R. Lathrobe, who for many years was chief engineer of the Baltimore and Ohio Railroad wrote about this "Grasshopper" engine:-

> "The engine was constructed with special reference to the weak track and strong curves of the Baltimore and Ohio Railway . It was made, therefore, of moderate weight and short coupled, so as to press lightly on the track and round the curves easily, and that it must have done this last is proved by its being able to work itself through the quadrant of sixty foot radius at the street corners. It was supported upon wheels of small diameter and to keep down the center of gravity, and also to give tractive power with a cylinder of moderate size and pressure of steam such as was used at that time. The upright boiler was adopted in view of the advantages already enumerated and of its successful use in the little engine of Mr. Cooper's, which seemed to give the maximum of steam generating capacity in the smallest compass, and hence to be especially favorable to the compactness required in so short an engine. The boiler affording readiest and staunchest support to the cylinder was naturally resorted to for that purpose. This gave them their vertical position, and involved the lever beam and long connecting rod or grasshopper legs. The separate shaft was

an accompaniment of the system of gearing required by the small wheels and relieved of its objections.

After the statement of this engineer, it may be interesting to note the attitude of the chief engineer of the road who, in 1830, said, - "with the steam locomotive an average of ten miles per hour could be attained and it might be possible to go higher, but, in his opinion, the speed of ten miles per hour should not be exceeded."

These foregoing data amply illustrate the American attributes of vision and stick-to-itiveness, and merely go to show what ambition, properly directed, may do. Had it not been for the application and persistance of the founders of the Baltimore and Ohio Railroad, coupled with a true belief in their product, the mode of transportation today would be not nearly so complete and comfortable. It is true, as this paper has shown, that the beginning was crude, but nothing has ever been developed which was not very incomplete at first.

Therefore, it is the opinion of the writer, that the American people in general owe a big debt to the founders of the Baltimore and Ohio Railroad and to the men who started real railroading with the early types of engine herein described.

The preparation of this paper has been greatly aided by, and most of the material has been supplied by, Mr. R. E. Kennedy, Room #1105, Baltimore and Ohio Building, Baltimore, Maryland, and I wish thus to thank him for his assistance.

I also consulted "The Development of the Locomotive Engine" by Angus Sinclair, whose book may be found in the Congressional Library, Washington, D. C.